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PATENT

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July 15, 2005
Date

Joanne Bourguignon
Joanne Bourguignon

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Warren B. Jackson et al.
Application No.: 10/608,791
Filed: June 26, 2003
Title: POLYMER-BASED MEMORY ELEMENTS

Examiner: Matthew E. Warren

Art Unit: 2815

Docket No.: 200207604-1

Date: June 17, 2005

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Alexandria, VA 22313-1450

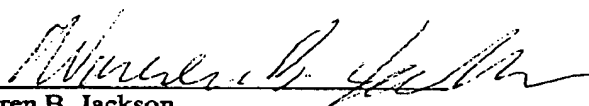
STATEMENT OF FACTS ESTABLISHING DILIGENCE RE 37 C.F.R. § 1.131

Sir:

We hereby provide Documentation and Research Results, which establish conception of the invention claimed in claims 1-32 of the above-identified patent application and a reduction to practice of an embodiment of the invention prior to the filing date of the cited reference, Stasiak, Publication No. US 2003/0230746, Pub. Date December 18, 2003, filed June 14, 2002.

EXHIBIT 1 - Documentation of Research Results – dated March 11, 2002;
EXHIBIT 2 - Documentation of Research Results – dated March 12, 2002
EXHIBIT 3 - Documentation of Research Results – dated March 13, 2002
EXHIBIT 4 - Documentation of Research Results – dated March 25, 2002
EXHIBIT 5 - Documentation of Research Results – dated April 10, 2002
EXHIBIT 6 - Documentation of Research Results – dated May 14, 2002
EXHIBIT 7 - Documentation of Research Results – dated May 21, 2002
EXHIBIT 8 - Documentation of Research Results – dated June 07, 2002

Inventors:



Warren B. Jackson



Date

Craig M. Perlov

Date

Sean Zhang

Date



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EXHIBIT 8 - Documentation of Research Results – dated June 07, 2002

Inventors:

Warren B. Jackson

Date

A handwritten signature in black ink, appearing to read "Craig M. Perlov".

Craig M. Perlov

June 17, 2005

Date

A handwritten signature in black ink, appearing to read "Sean Zhang".

Sean Zhang

June 17, 2005

Date



Practitioner's Docket No. 200207604-1

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Warren B. Jackson et al.

Application No.: 10/608,791

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For: POLYMER-BASED MEMORY ELEMENTS

**Commissioner for Patents
Washington, DC. 20231**

**DECLARATION OF PRIOR INVENTION IN THE UNITED STATES
OR IN A NAFTA OR WTO MEMBER COUNTRY
TO OVERCOME CITED PATENT OR PUBLICATION (37 C.F.R. § 1.131)**

PURPOSE OF DECLARATION

1. This declaration is to establish completion of the invention in this application in the United States, at a date prior to June 14, 2002 that is the effective filing date of the prior art:

X publication

 patent

that was cited by the

X examiner.

 applicant.

CERTIFICATE OF MAILING/TRANSMISSION (37 C.F.R. § 1.8(a))

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Date JUL 15, 2005

Joanne Bourguignon
Signature

Joanne Bourguignon

(type or print name of person certifying)

(Declaration of *Prior* Invention In the United States or in a NAFTA or WTO Member Country to Overcome Cited Patent or Publication—37 C.F.R. § 1.131 [g-32] - page 1 of 5)

NOTE: "When any claim of application or a patent under reexamination is rejected under 35 U.S.C. 102(a) or (e), or 35 U.S.C. 103 based on a U.S. patent to another or others which is prior art under 35 U.S.C. 102(a) or (e) and which substantially shows or describes but does not claim the same patentable invention, as defined in 37 C.F.R. 1.601(n), or a reference to a foreign patent or to a printed publication, the inventor of the subject matter of the rejected claim, the owner of the patent under reexamination, or the party qualified under §§ 1.42, 1.43 or 1.47, may substitute an appropriate oath or declaration to overcome the patent or publication. The oath or declaration must include facts showing a completion of the application in this country or in a NAFTA or WTO member country before the filing date of the application on which the U.S. patent issued, or before the date of the foreign patent, or before the date of the printed publication. When an appropriate oath or declaration is made, the patent or publication cited shall not bar the grant of a patent to the inventor or the confirmation of the patentability of the claims of the patent, unless the date of such patent or printed publication is more than one year prior to the date on which the inventor's or patent owner's application was filed in this country." 37 C.F.R. § 1.131(a)(1).

NOTE: 37 C.F.R. § 1.131 Is not applicable to a rejection based on a U.S. patent that CLAIMS the rejected invention.

2. The person making this declaration is (are):

- ☒ the Inventor(s).
- ☐ only some of the joint inventor(s)
(and a suitable excuse is attached for failure of the omitted joint inventor(s) to sign)
- ☐ the party in interest
(and a suitable explanation as why it is not possible to produce the declaration of the inventor(s) is attached)

FACTS AND DOCUMENTARY EVIDENCE

3.

NOTE: The showing of facts shall be such, in character and weight as to establish reduction to practice prior to the effective date of the reference, or conception of the invention prior to the effective date of the reference coupled with due diligence from prior to said date to a subsequent reduction to practice or to the filing of the application. 37 C.F.R. § 1.131(b).

To establish the date of completion of the invention of this application, the following attached documents and/or models are submitted as evidence:

(check all applicable items below)

- ☐ sketches
- ☐ blueprints
- ☐ photographs
- ☒ Reproduction(s) of Research Results
- ☐ disclosure
- ☐ supporting statement(s) by witness(es) (where verbal disclosures are the evidence, relied upon)

NOTE: While conception is the mental part of the inventive act, it must be capable of proof, such as by demonstrative evidence or by complete disclosure to another. Conception is more than a vague idea of how to solve a problem. The requisite means themselves and their interaction must also be comprehended. See *Margenthaler v. Scudder* 1897 C.D. 724, 81 O.G. 1417. See also M.P.E.P. § 715.07 and § 2138.04, 7th ed.

From these documents and/or models, it can be seen that the invention in this application was made

on _____
X at least by the date of March 11, 2002 which is a date earlier than the effective date of the reference.

NOTE: "If the dates of the exhibits have been removed or blocked off, the matter of dates can be taken care of in the body of the oath or declaration." M.P.E.P. § 715.07, 7th ed.

NOTE: "[T]he dates in the oath or declaration may be the actual dates, or, if the applicant or patent owner does not desire to disclose his or her actual dates, he or she may merely allege that the acts referred to occurred prior to a specified date." M.P.E.P. § 715.07, 7th ed.

DILIGENCE

NOTE: "Where there has not been reduction to practice prior to the date of the reference, the applicant or patent owner must also show diligence in the completion of his or her invention from a time just prior to the date of the reference continuously up to the date of the actual reduction to practice or up to the date of filing his or her application (filing constitutes a constructive reduction to practice, § 1.131). "M.P.E.P. § 715.07, 6th ed., rev. 3 (emphasis added).

NOTE: "A conception of an invention, though evidenced by disclosure, drawings, and even a model, is not a complete invention under the patent laws, and confers no rights on a inventor, and has no effect on a subsequently granted patent to another, UNLESS HE OR SHE FOLLOWS IT WITH REASONABLE DILIGENCE BY SOME OTHER ACT, such as an actual reduction to practice or filing an application for a patent. *Automatic Weighing Mach. Co v. Pneumatic Scale Corp., Limited* 1909 C.D. 498, 139 O.G. 991, M.P.E.P. § 715.07, 7th ed.
"Conception in the mental part of the inventive act, but it must be capable of proof, as by drawings, complete disclosure to another person, etc., In *Mergenthaler v. Scudder*, 1897 ca 724, 81 O.G. 1417, it was established that conception is more than a mere vague idea of how to solve a problem; the means themselves and their interaction must be comprehended also." M.P.E.P. § 715.07, 7th ed.

NOTE: Only diligence before reduction to practice is a material consideration. The "lapse of time between the completion or reduction to practice of an invention and the filing of an application thereon." (Ex parte Merz 74 U.S.P.Q. 296) is not relevant to an affidavit or declaration under 37 C.F.R. § 1.131. M.P.E.P. § 715.07(a), 7th ed.

Attached is a statement establishing the diligence of the applicants, from the time of their conception, to a time just prior to the date of the reference, up to the:

___ actual reduction to practice.
X filing of this application.

TIME OF PRESENTATION OF THE DECLARATION

(complete (a), (b) or (c))

- (a) X This declaration is submitted with the filing of the RCE under 37 CFR 1.114.
(b) ___ This declaration is submitted with the first response after final rejection, and is for the purpose of overcoming a new ground of rejection or requirement made in the final rejection.
(c) ___ This declaration is submitted after final rejection. A showing under 37 C.F.R. § 1.116(b) is submitted herewith.

**DECLARATION****6. As a person signing below:**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)**7. (complete A or B below)****A. Inventor(s)**Full name of sole or first inventor Warren B. JacksonInventor's signature Warren B. JacksonDate 6/20/05 Country of Citizenship USAResidence 160 Castaneda Ave San Francisco CAPost Office Address SameFull name of second joint inventor, if any Craig M. Perlov

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

Full name of third joint inventor, if any Sean Zhang

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

(use added page for signature by additional inventors)

(Declaration, of Prior Invention In the United States, or In a NAFTA or WTO Member Country to Overcome
Cited Patent or Publication--37 C.F.R. § 1.151 [g-32] page 4 of 5)



DECLARATION

6. As a person signing below:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

7. (complete A or B below)

A. Inventor(s)

Full name of sole or first inventor Warren B. Jackson

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

Full name of second joint inventor, if any Craig M. PerlovInventor's signature C. PerlovDate June 17, 2005 Country of Citizenship USAResidence 46 Treetop Ln San Mateo, CA 94402

Post Office Address _____

Full name of third joint inventor, if any Sean ZhangInventor's signature Sean ZhangDate June 17, 2005 Country of Citizenship USA

Residence _____

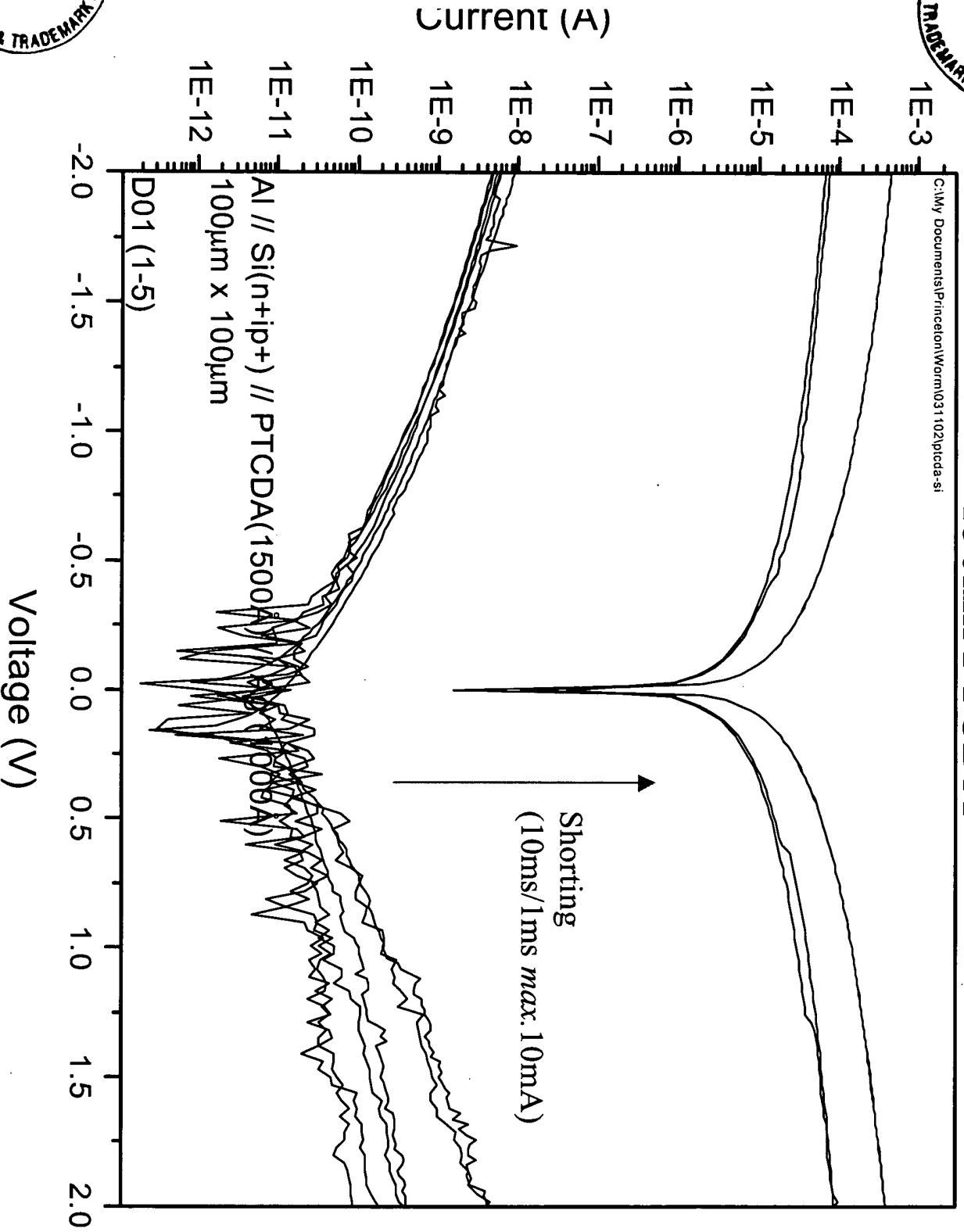
Post Office Address 10213 Miller Ave Cupertino, CA 95014

(use added page for signature by additional inventors)

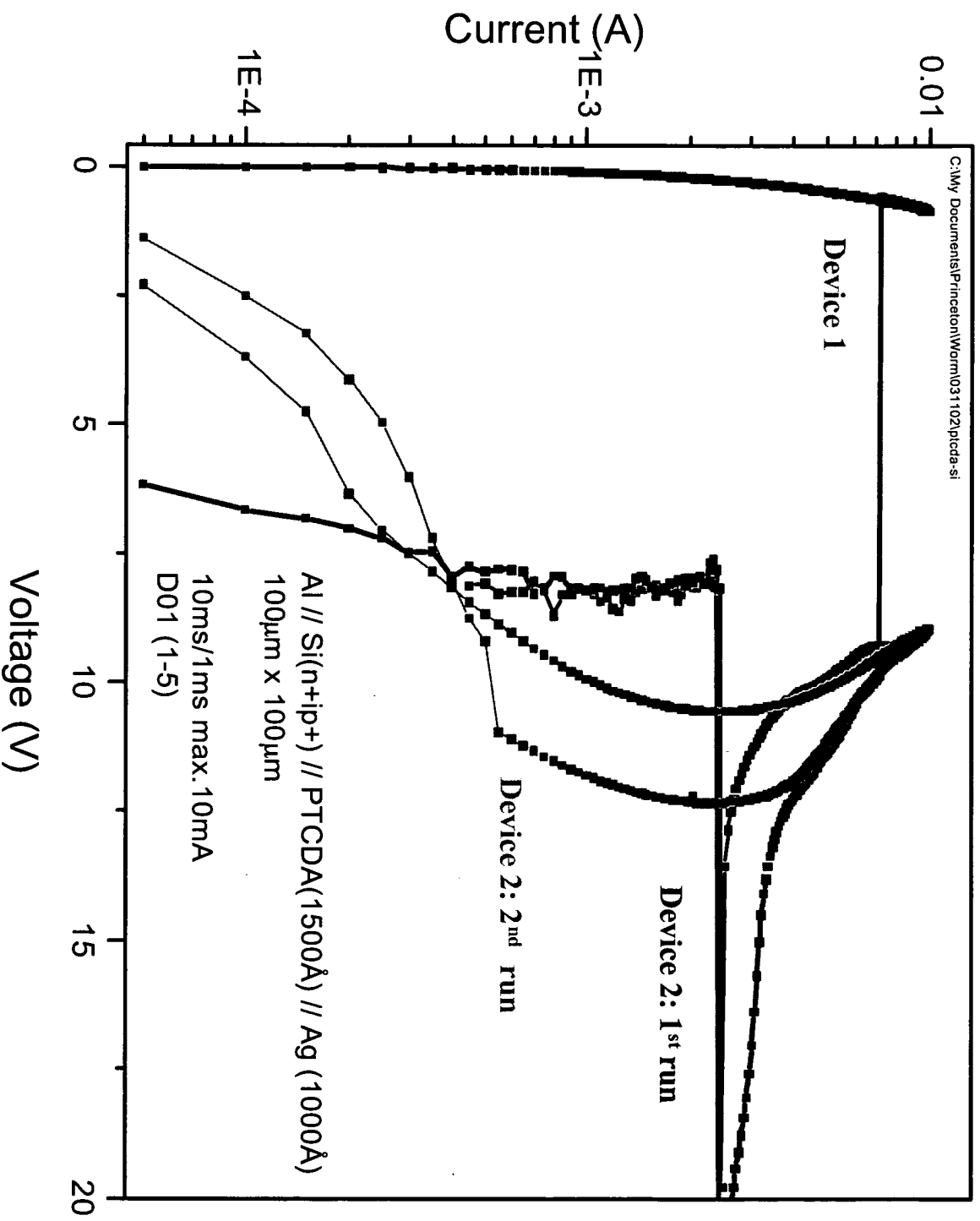
(Declaration of Prior Invention in the United States, or in a NAFTA or WTO Member Country to Overcome
Cited Patent or Publication—37 C.F.R. § 1.151 [g-32] page 4 of 5)



150nm PTCDA



150nm PTCDA – Writing (bubbles and destruction)

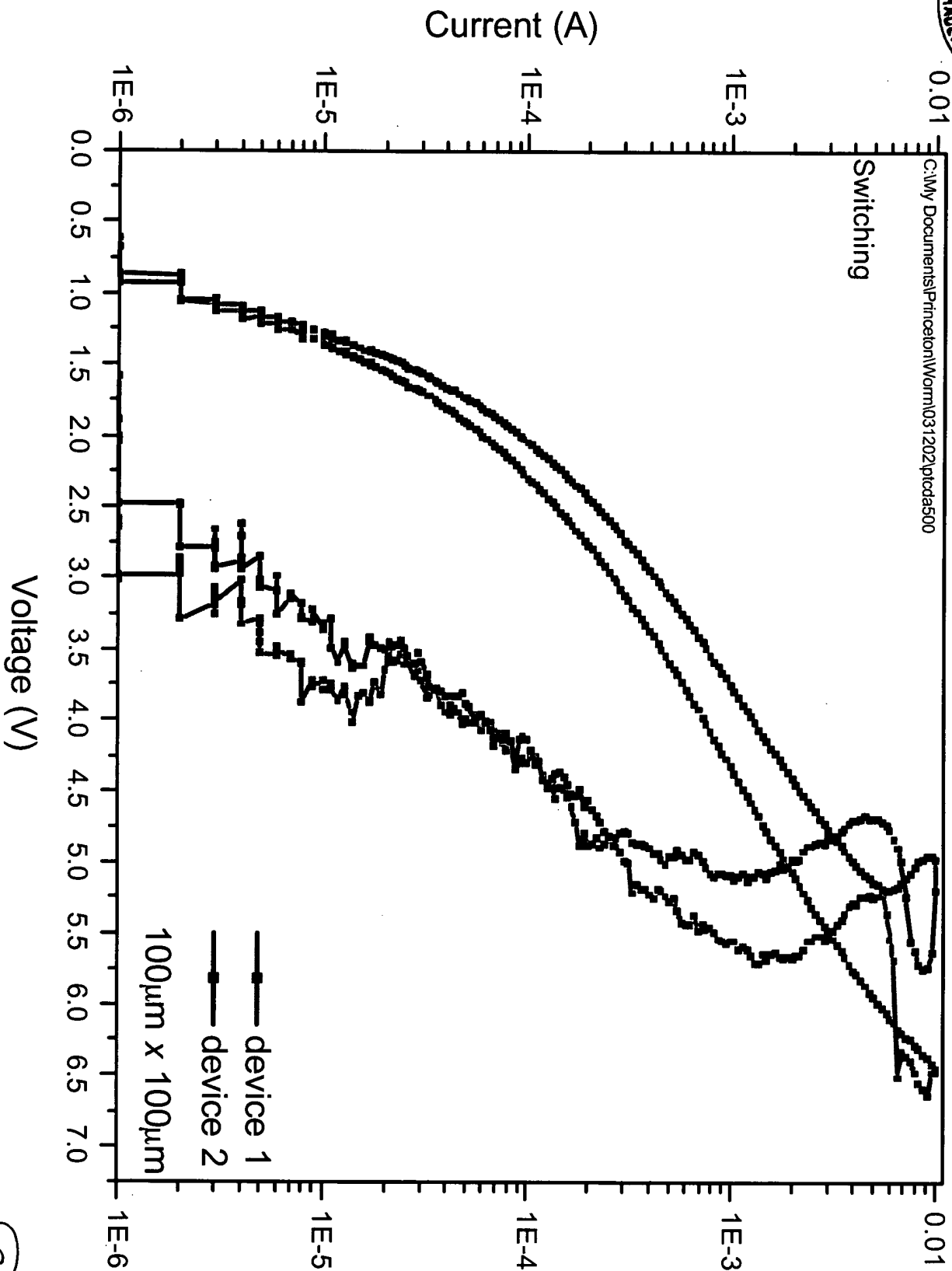




Current Pulses (50ms/5ms *max.* 10mA) – 50nm PTCTDA

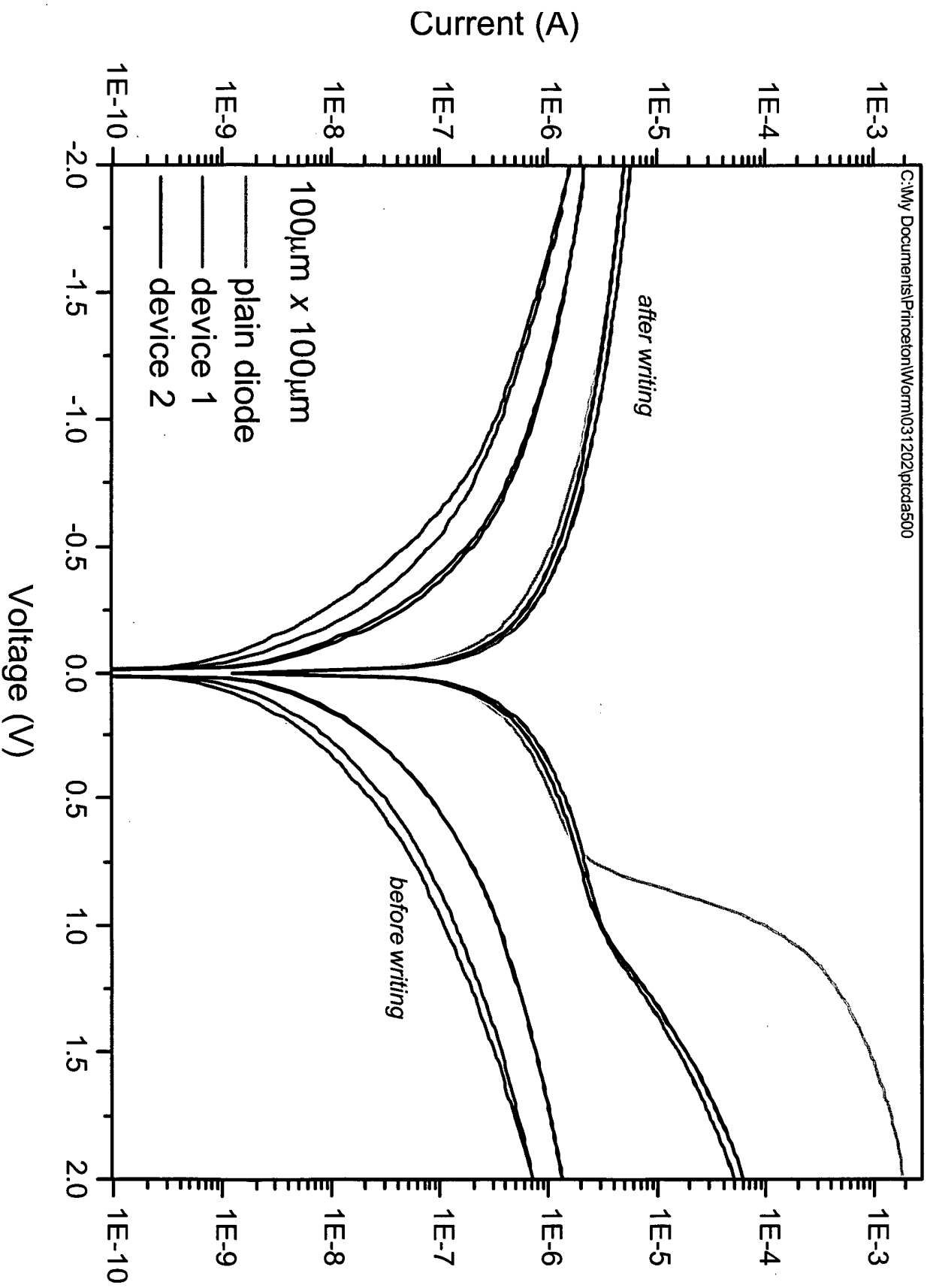
C:\My Documents\Princeton\Worm\031202\ptcda500

Switching



Written device – 50nm PTCD

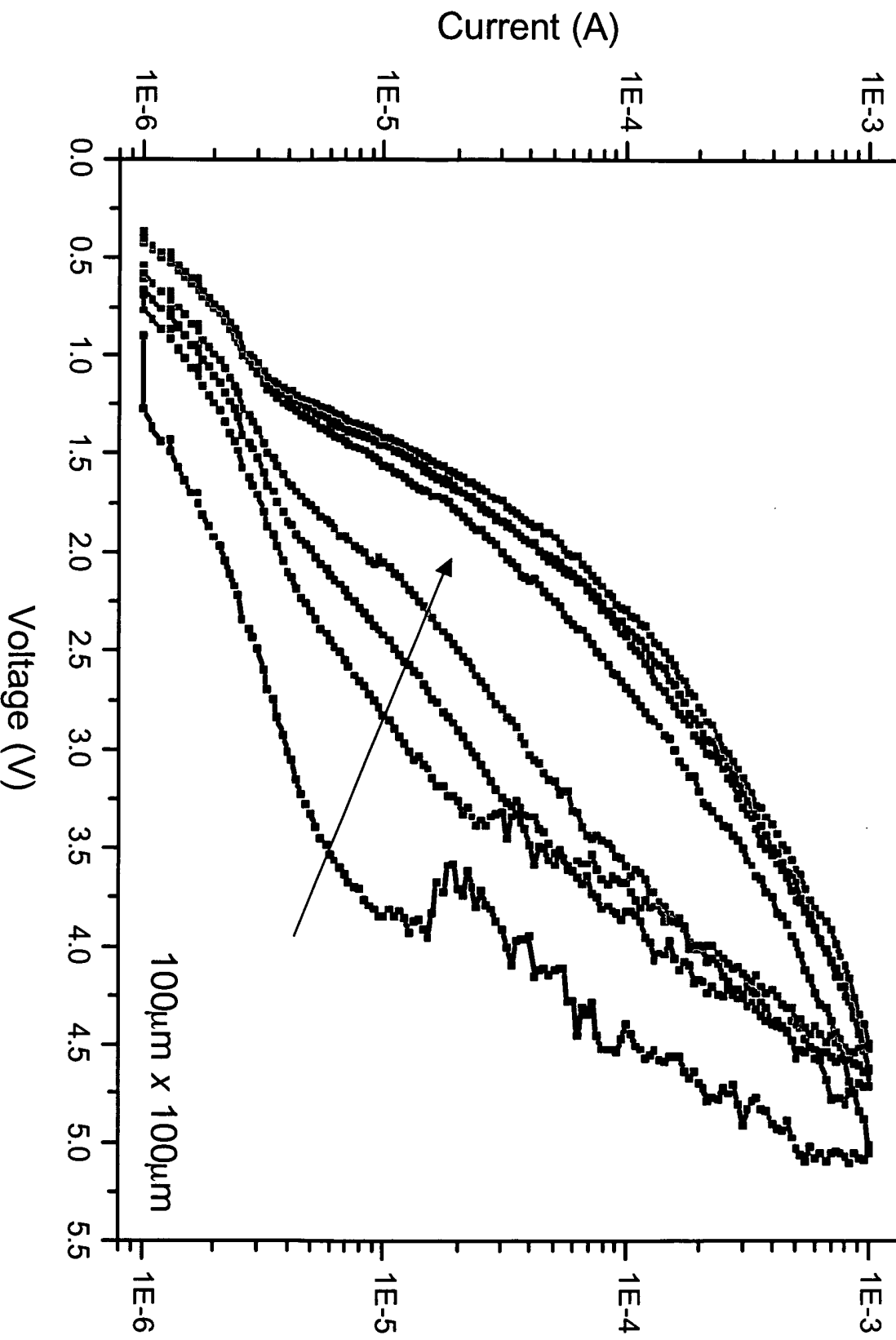
C:\My Documents\Princeton\Worm\031202\ptcda500



Writing multiple times (50ms/5ms *max.* 1mA) – 50nm PTCDA

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Switching



Shelf-test (PTCDA)

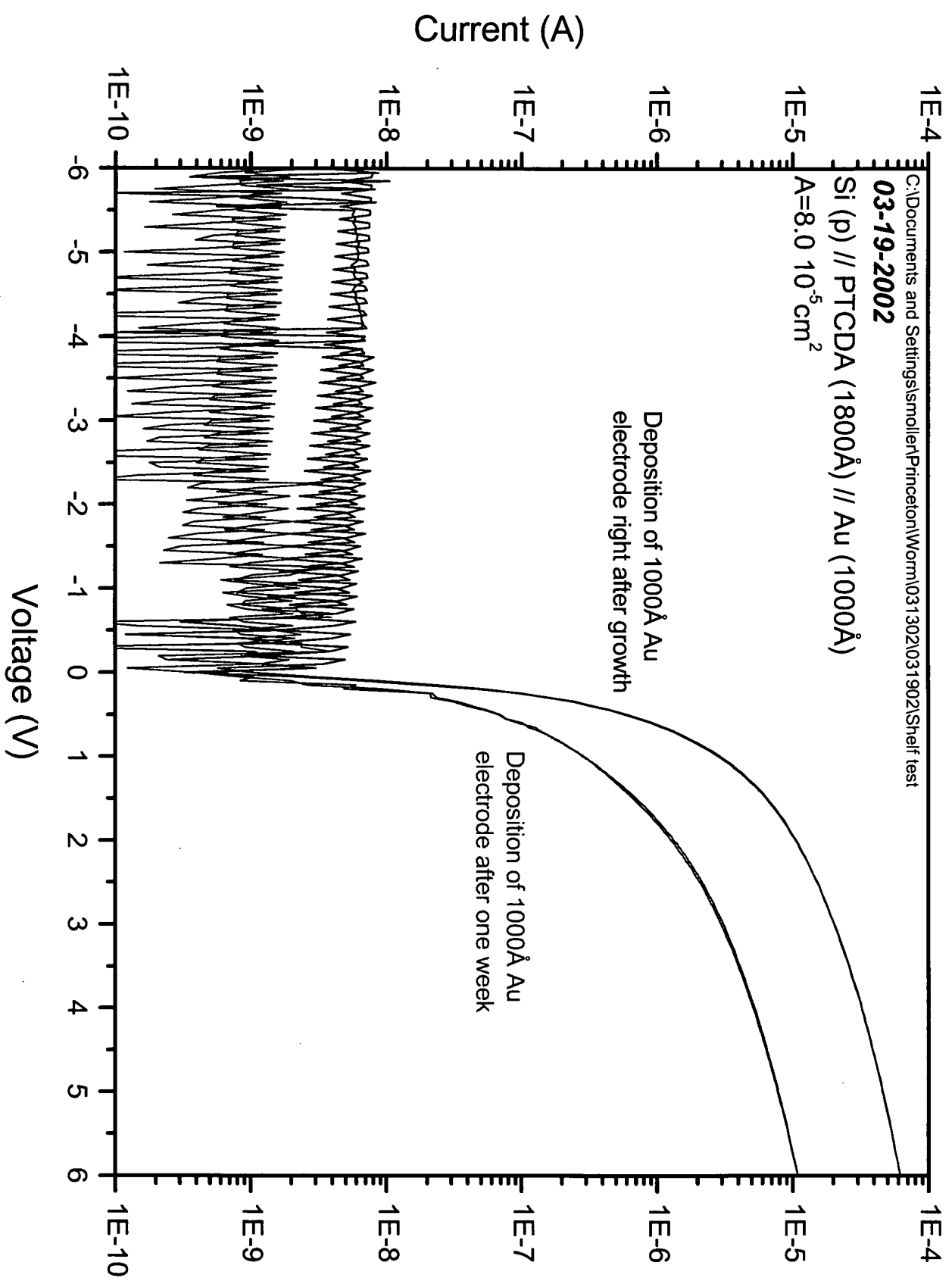
- Both samples:
1800 Å PTCDA on p-Si
1000 Å Au top contact
- First sample (A): Top contact evaporated directly after thin film growth.
Characterized and stored in N₂-box.
- Second sample (B): Top contact evaporated after 1 week storage in ambient atmosphere
- Result: (better than previous results: rect. $\sim 10^2$)
 - A not changed after 1 week (I-V before and after the same)
rectification 10^4
 - B current ten times smaller than A
same rectification

C:\Documents and Settings\smoller\Princeton\Worm\031302\031902\Shelf test

03-19-2002

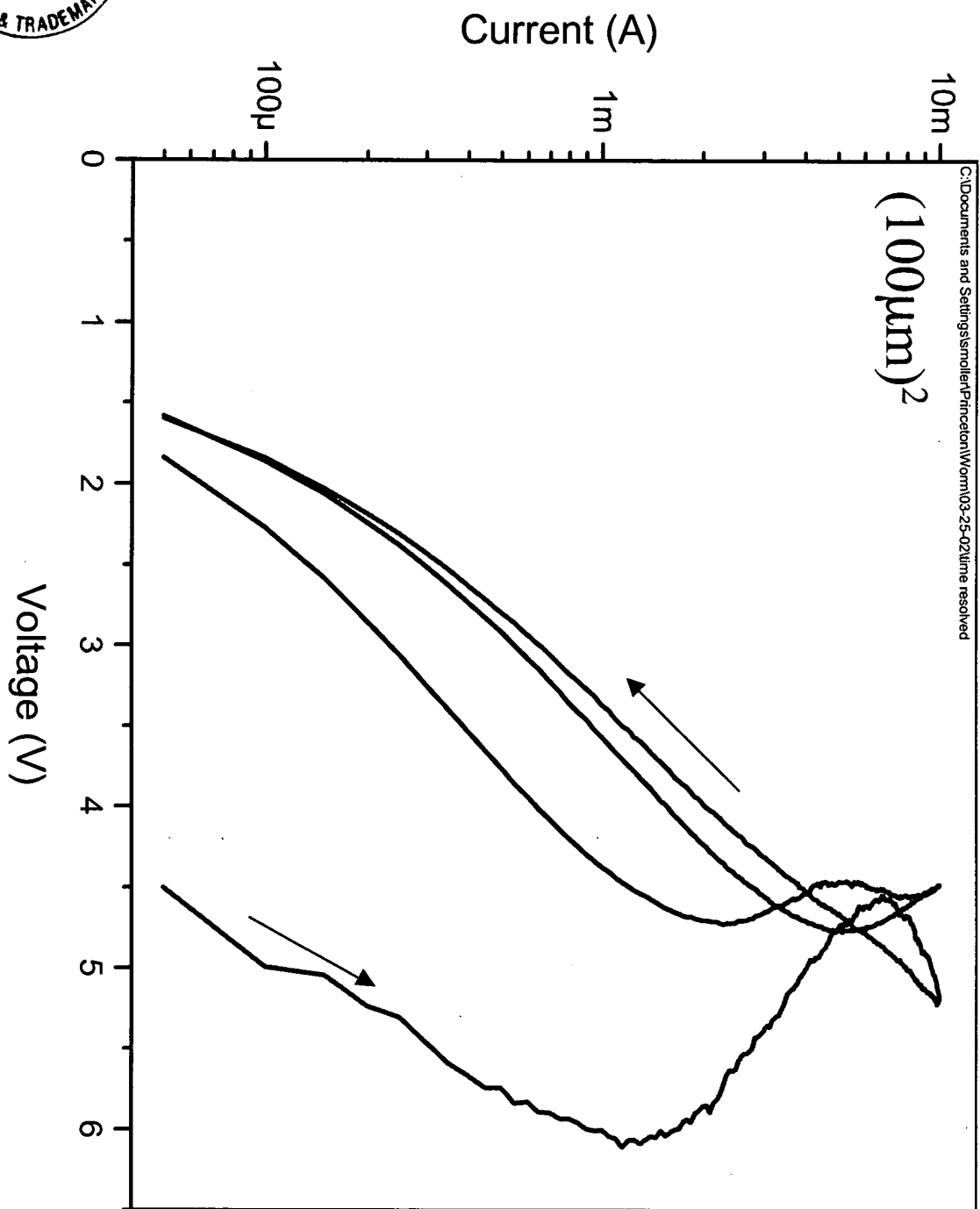
Si (p) // PTCDA (1800Å) // Au (1000Å)

A=8.0 10⁻⁵ cm²





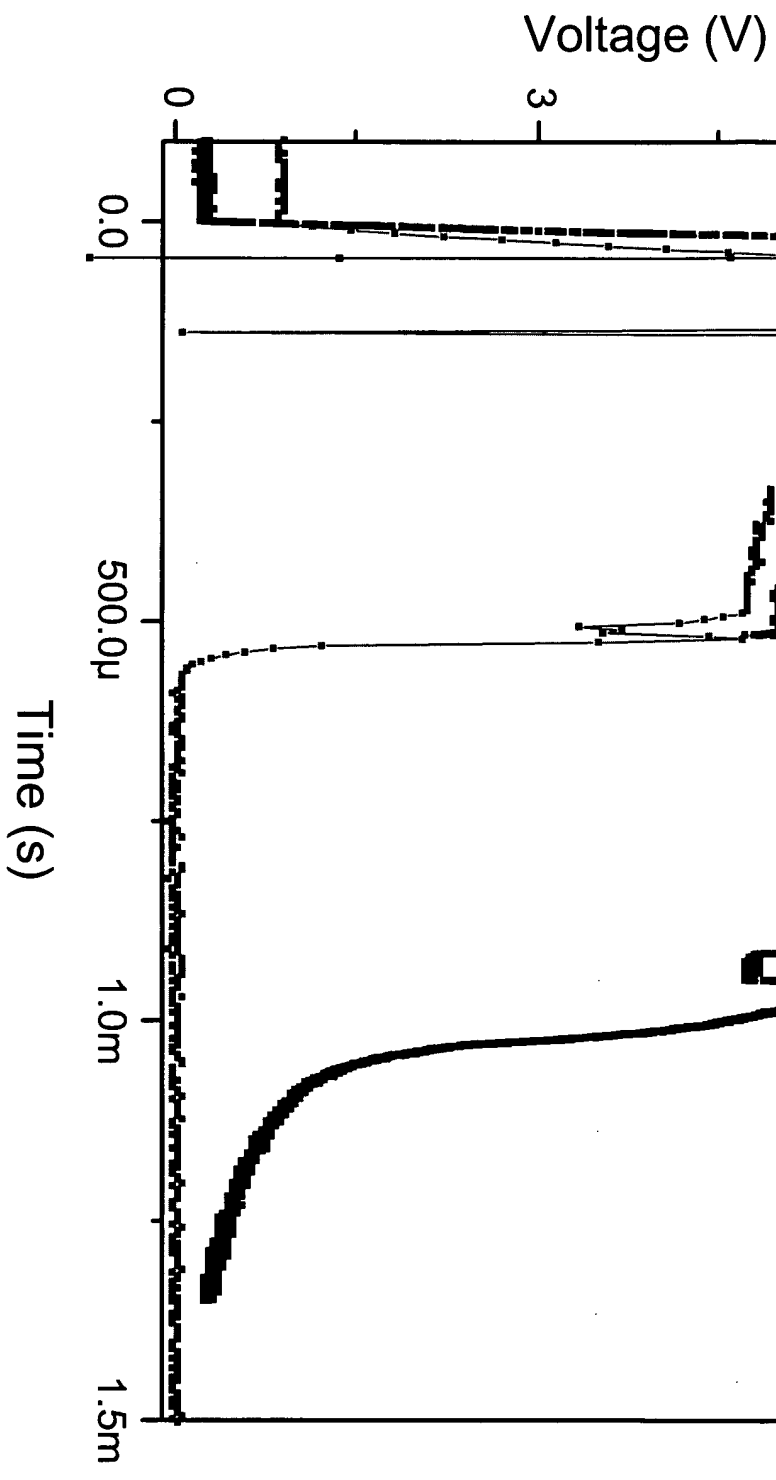
Typical current pulse sweeps [500Å PTCDA on Si(n⁺ip⁺)]



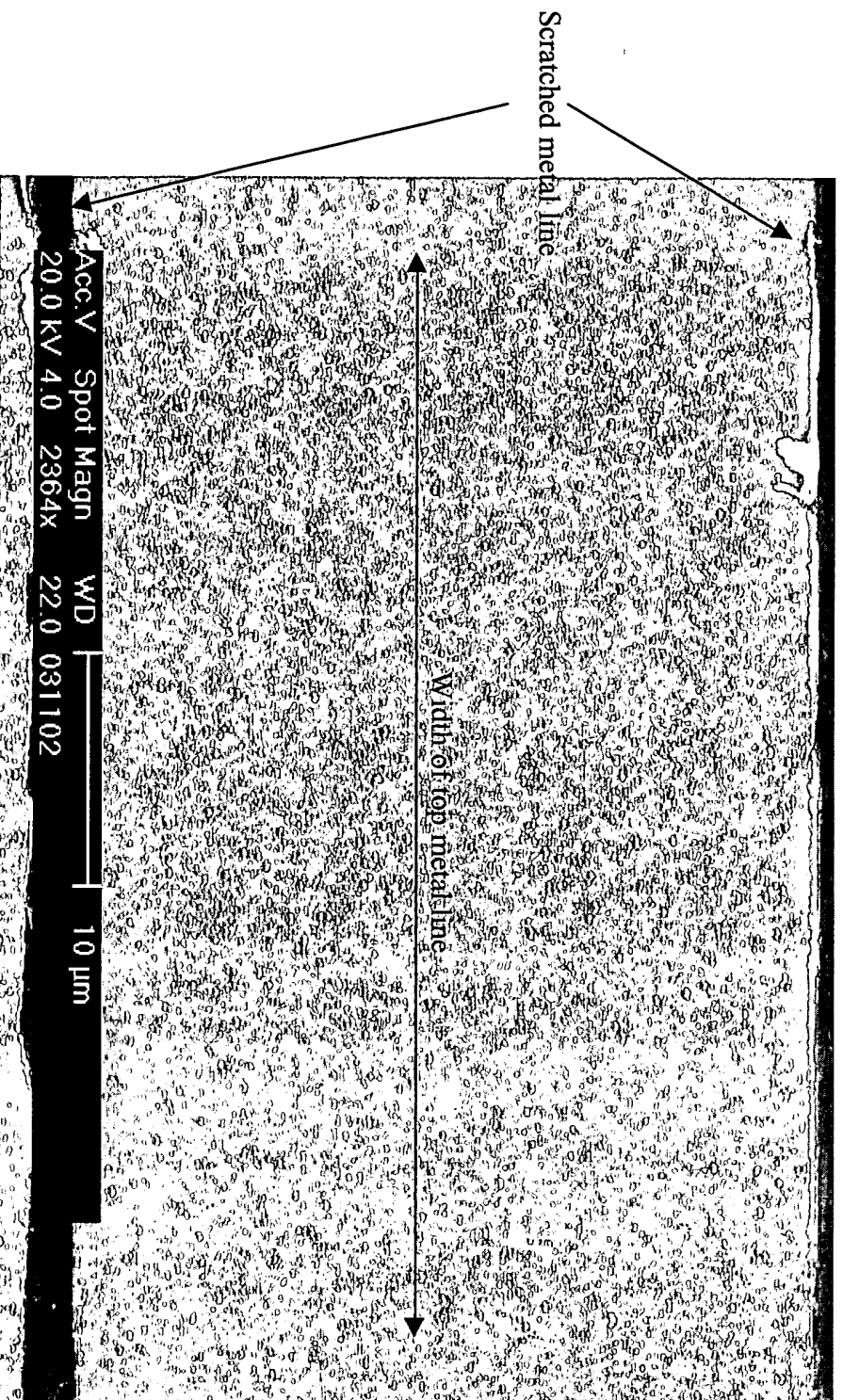
Voltage during constant-current-pulse

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10mA pulses – 0.5ms/1ms

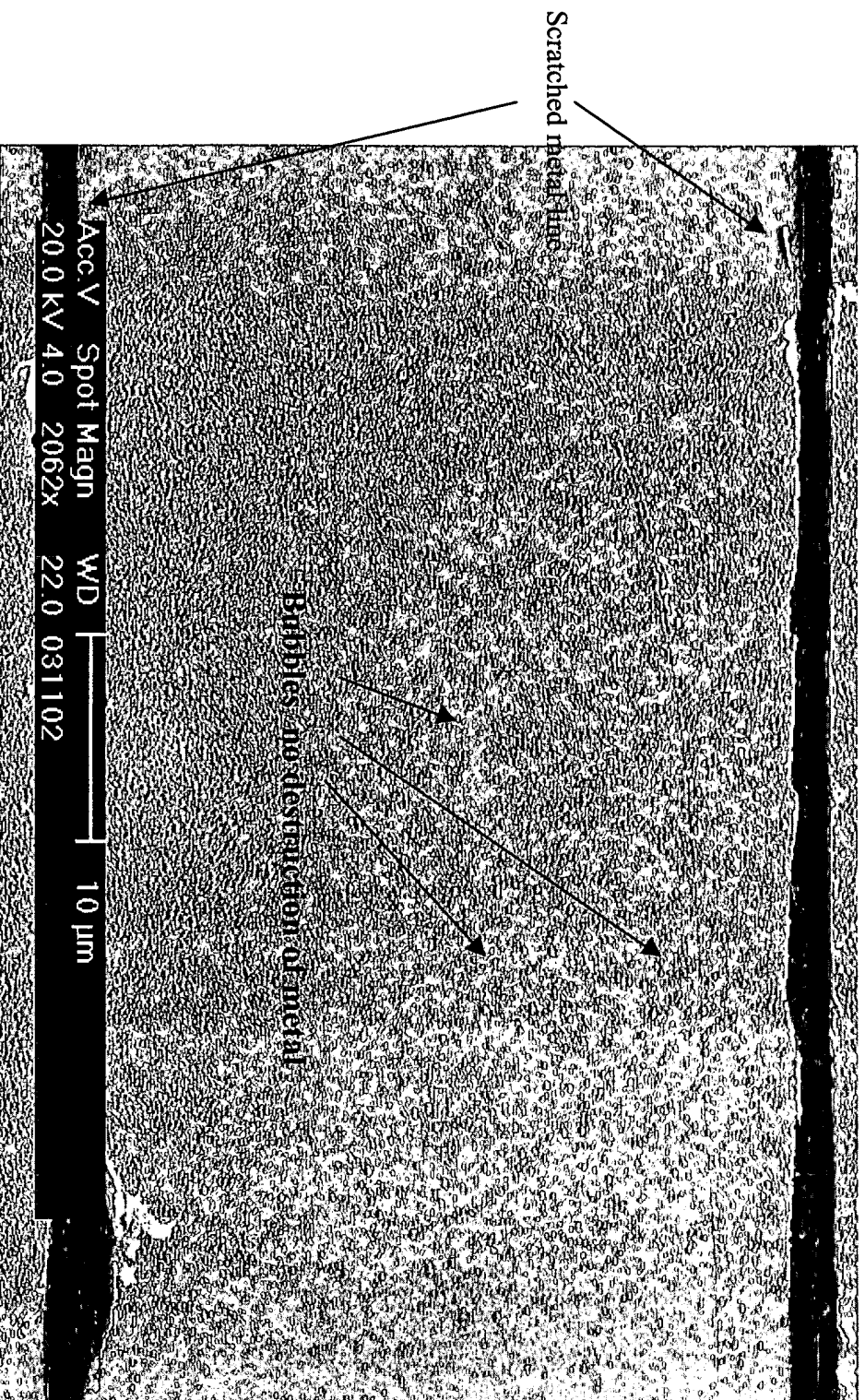


Changes of the cathode after stressing the device



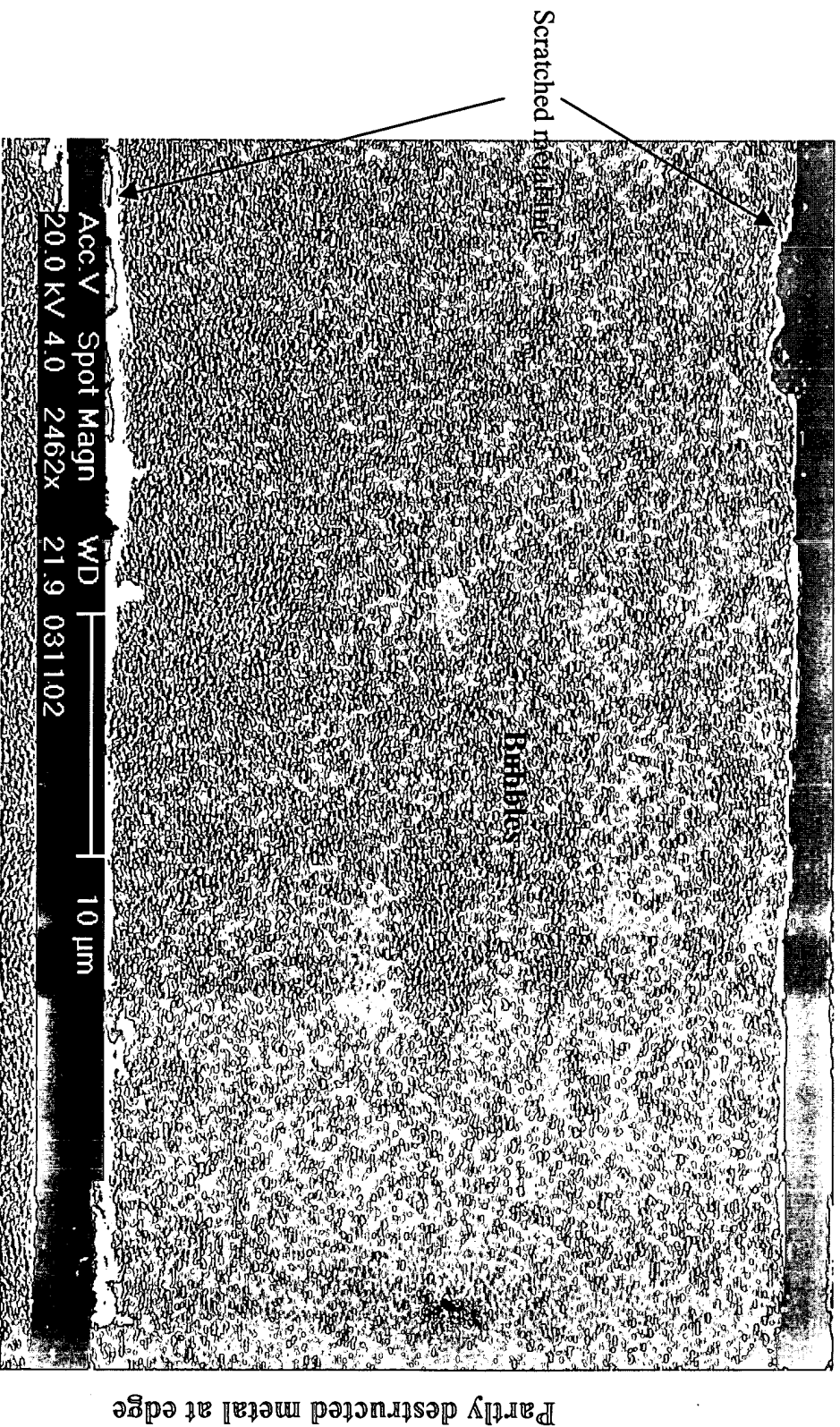
No observable changes – Organics shorted

Changes of the cathode after stressing the device



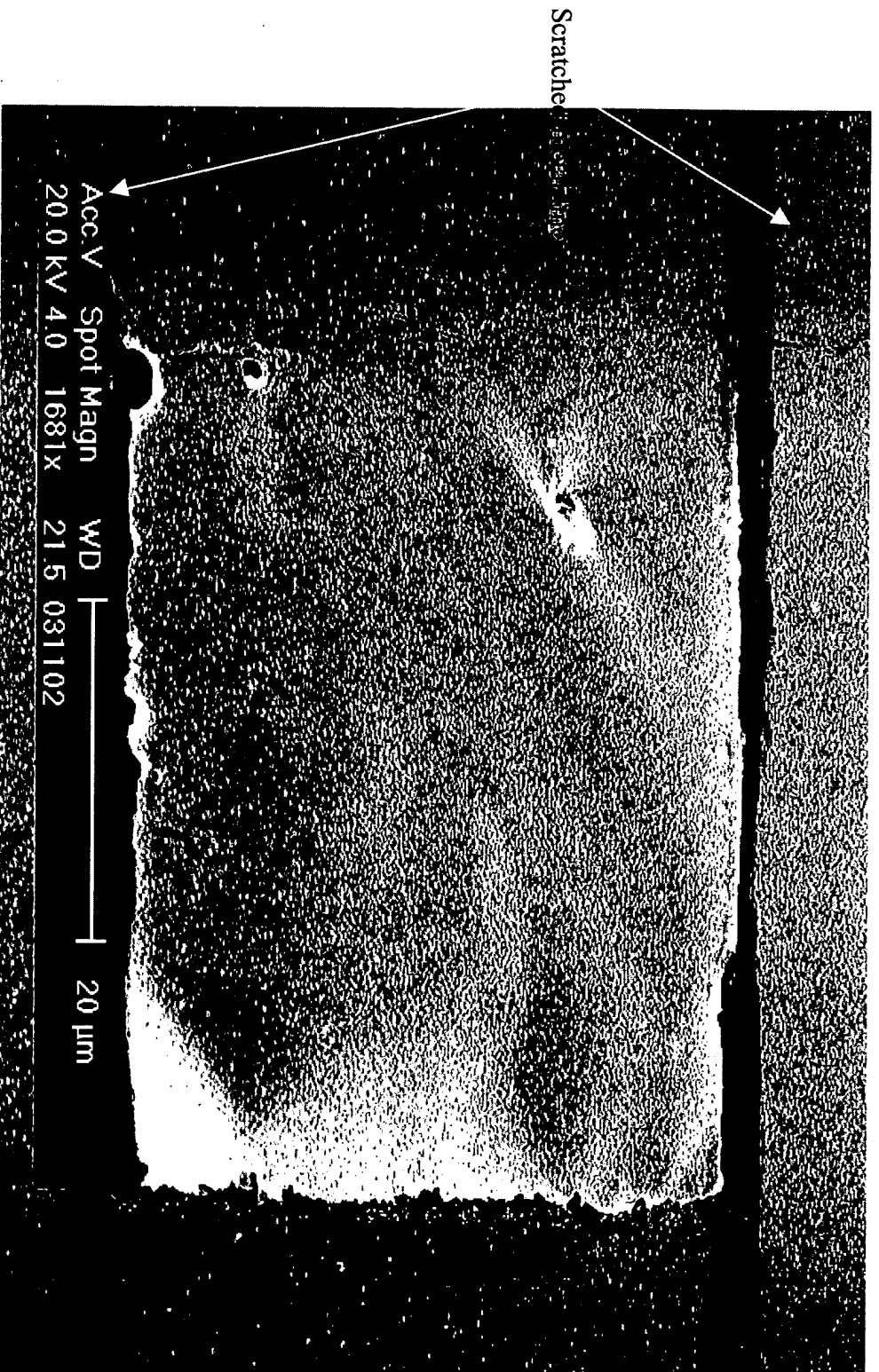
Bubble formation – Organics shorted

Changes of the cathode after stressing the device



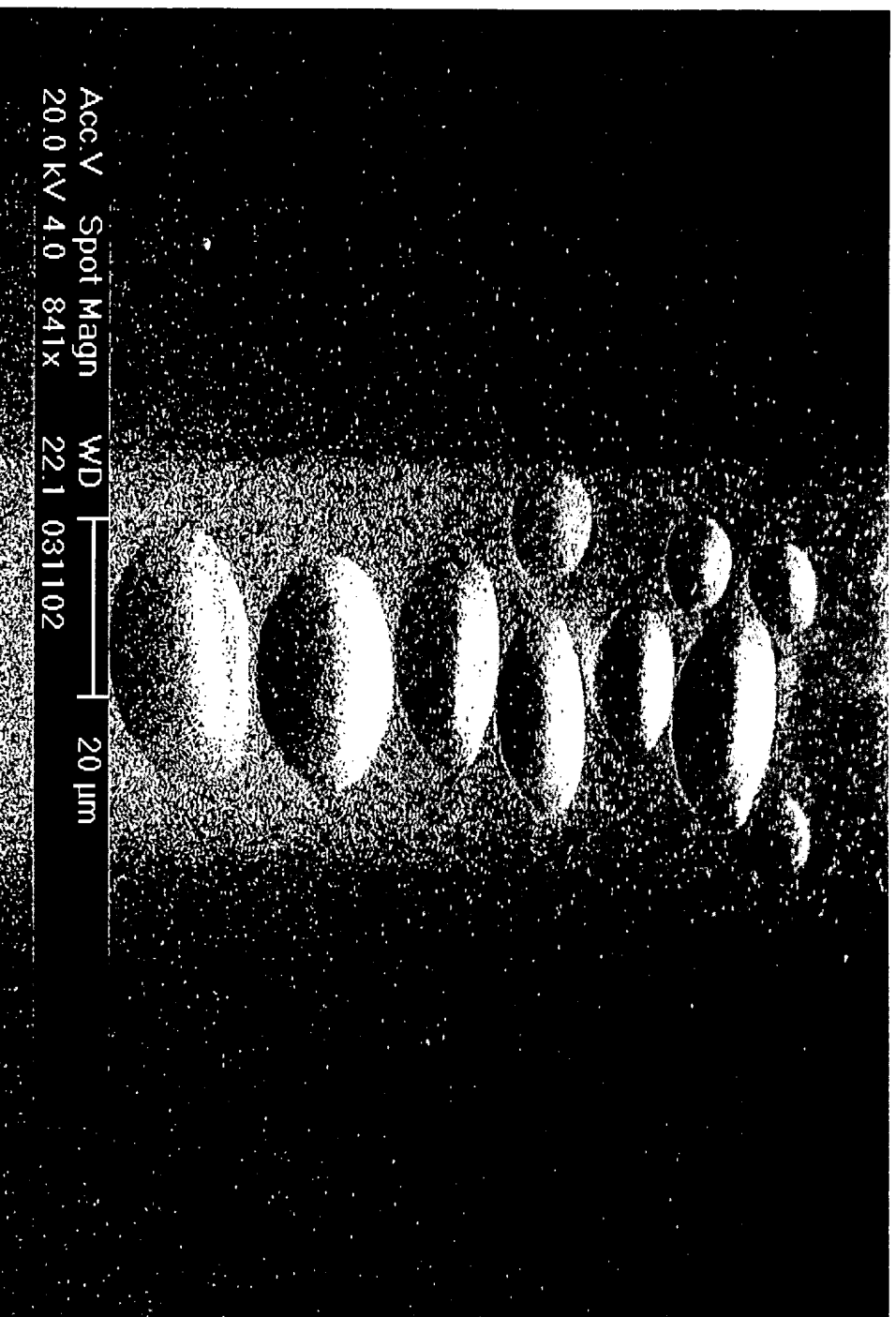
Bubble formation – Organics and Si shorted

Changes of the cathode after stressing the device



Whole cathode lifts off – completely shorted

Changes of the cathode after stressing the device



Whole line contacted – “weakest” part shows bubble formation



Data for discussion on 04-10-2002

Starting Point:

- Test different organic materials on top of the Si diodes (also thinner)

Purpose: Switching is the function of organics

→ before writing Si characteristic should dominate

→ make organics thinner – try different materials

Observation:

- I-Vs show peculiar behavior of the hybrid devices – not very reproducible
- Similar peculiar results for different materials and pure Si
- After taking I-Vs the device can be switched with light!?
- Absolutely no changes of the top metal

Reference Experiment:

- Check Si diode in its pristine state
- No Isopropanol cleaning
- No metal evaporated – Au wire loaded on the Si directly

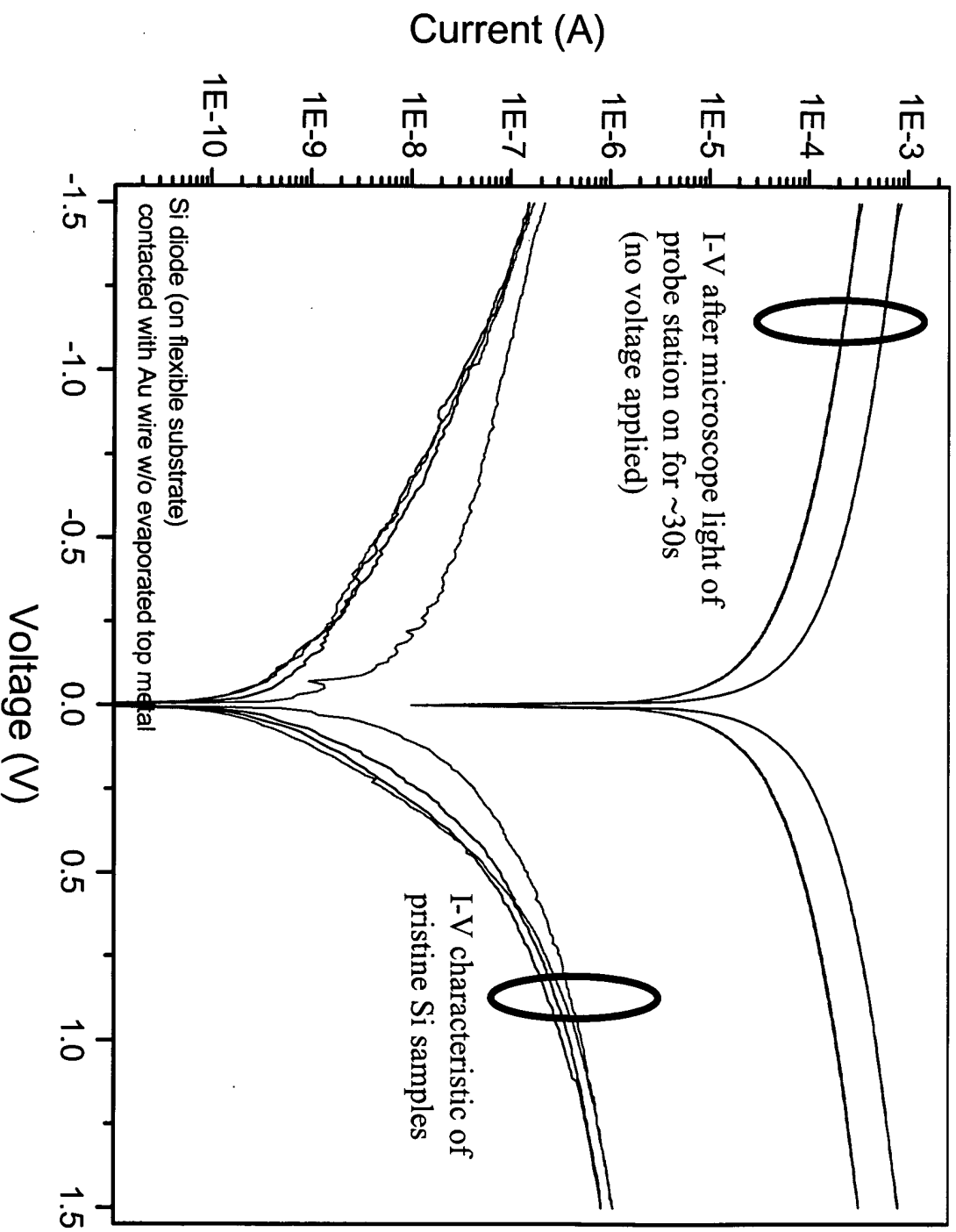
Conclusions/Questions

- Re-check previous results with PTCD A
- Similar results with Si @HP?
- Additional photo-excited carriers mediate filament formation in Si??



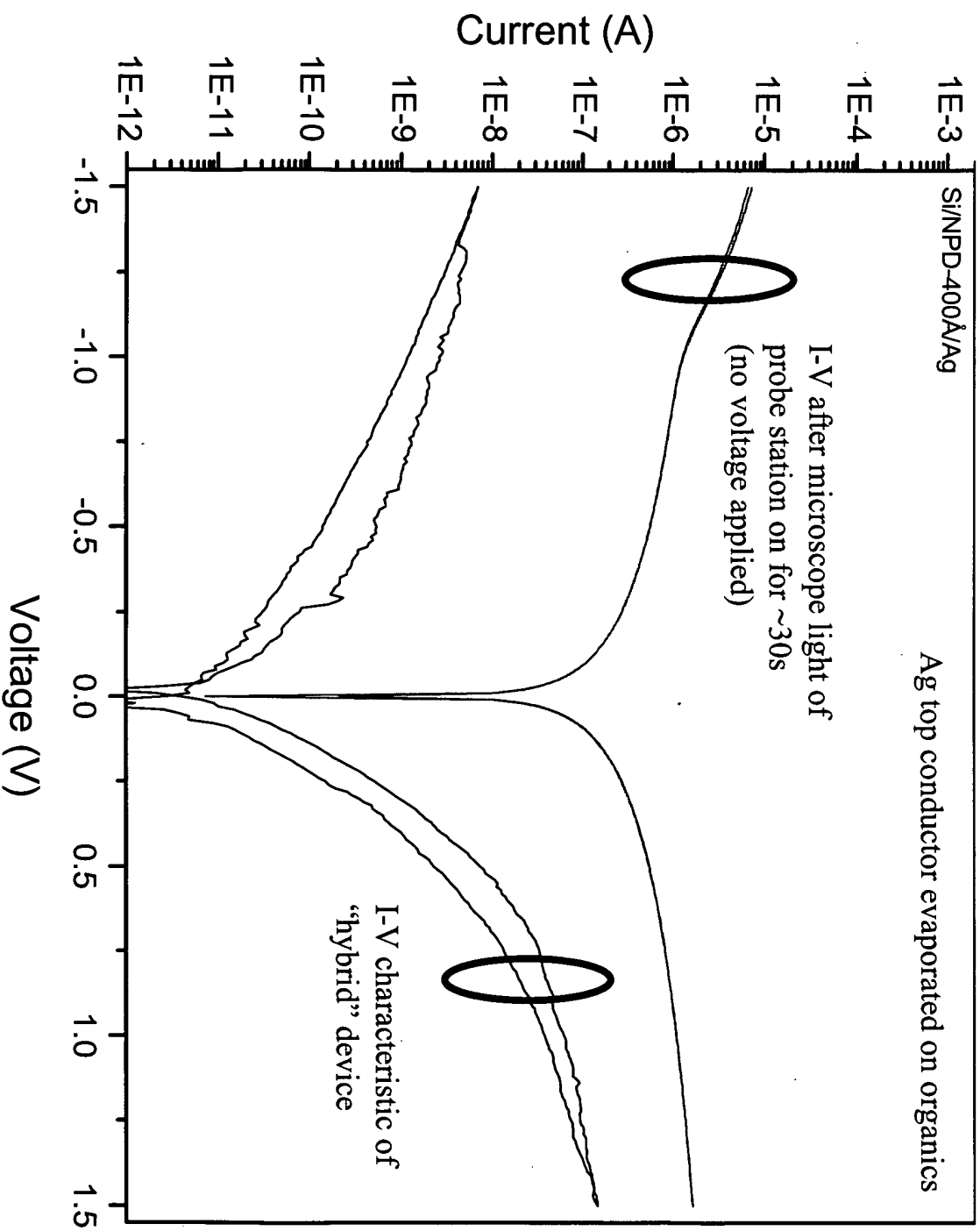
Peculiar behavior of Si diodes

Devices not stressed above 1.5V – no current sweep either.



Si diodes w/organic layer: 400Å NPD

Devices not stressed above 1.5V – no current sweep either.





Organic Switches

Conducting Polymers

- Processing: Spin coating, drop casting
- Electrical properties
electric conductivity $\kappa < 10^2 \text{ S/cm}$
higher current densities

Doping of small molecule

- Processing: Thermal evaporation
- Electrical properties
 $\kappa \sim 10^{-7} \text{ S/cm}$
high carrier density (high I-low V)

Resistance $R = \rho \cdot \frac{l}{A} = \frac{l}{\kappa \cdot A}$

with conductivity $\kappa = n \cdot \mu$

Higher conductivity for polymers reported in literature.

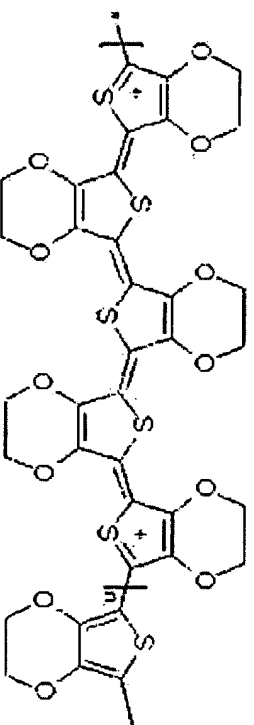
Doping of small molecules used to reduce operating voltages for organic light emitting diodes.



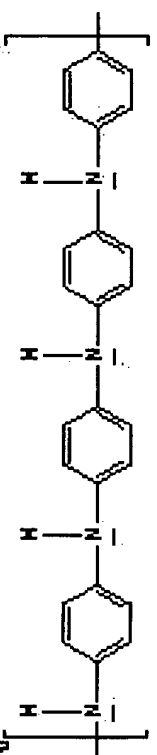
Conducting polymers

PEDT/PSS (Bayer AG)

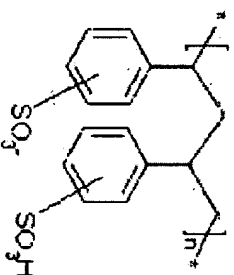
Poly(3,4-ethylenedioxythiophene)±Poly(styrene sulfonate)



Polyaniline (Ormecon)

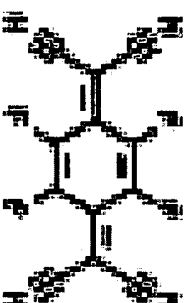
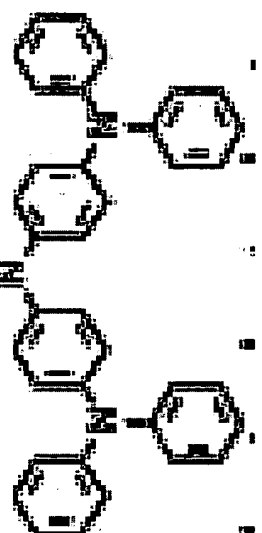


PEDT/PSS



Doping of small molecules

MTDATA: F₄TCNQ



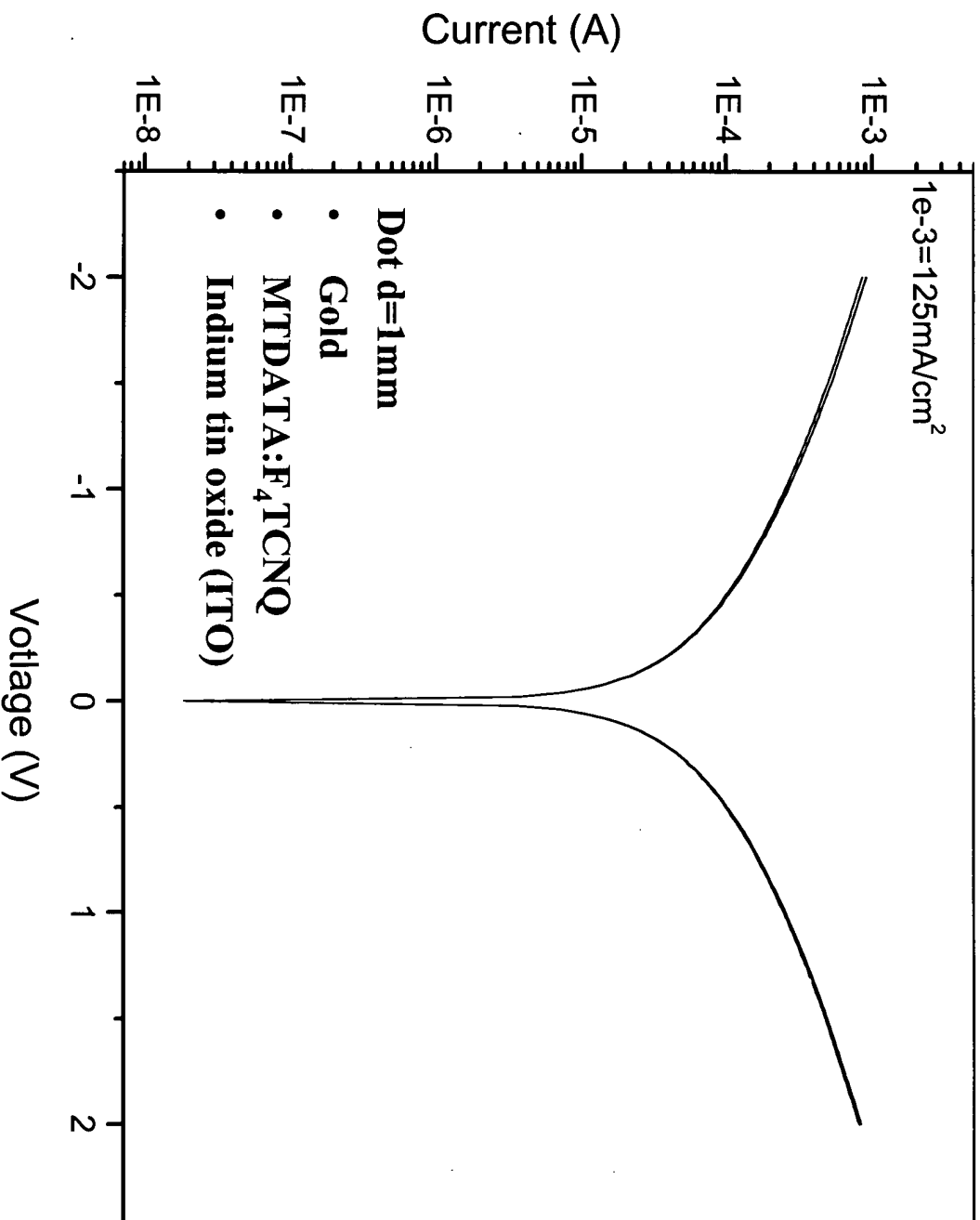
Dopant: F₄TCNQ



Matrix: MTDATA

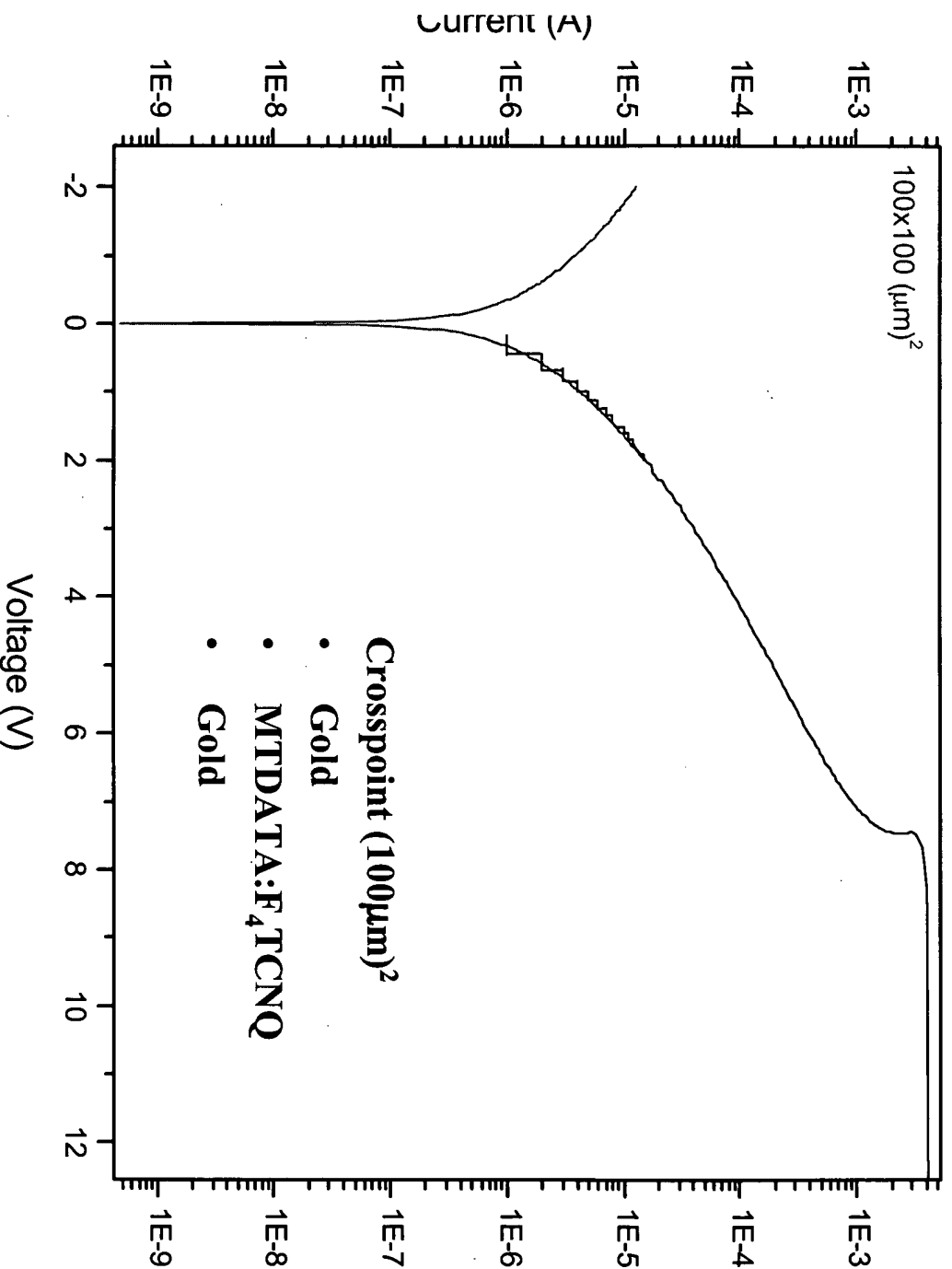
MTDATA:F₄TCNQ

No corresponding data for conducting polymers yet

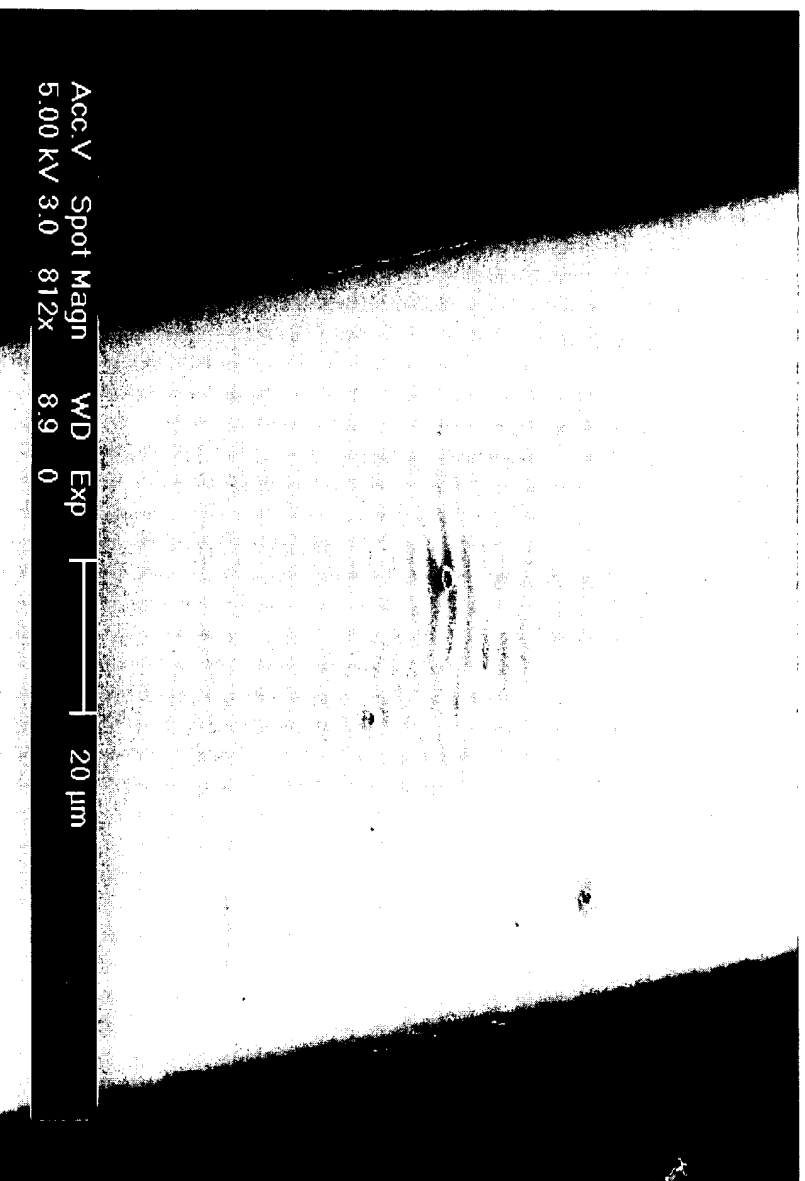


Open Circuit: Breakdown @~30A/cm²

Only device with open circuit out of ~15



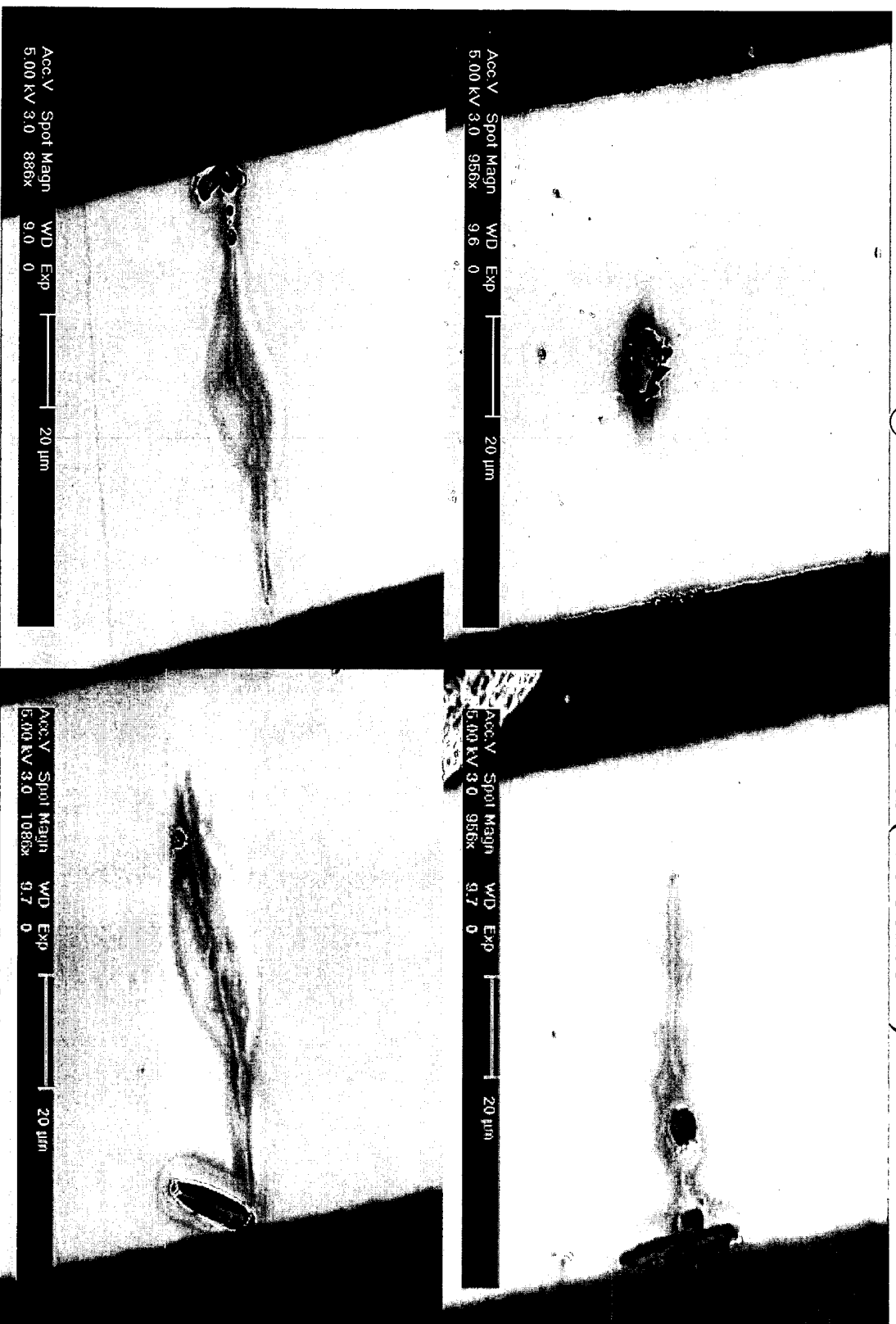
Crosspoint after breakdown

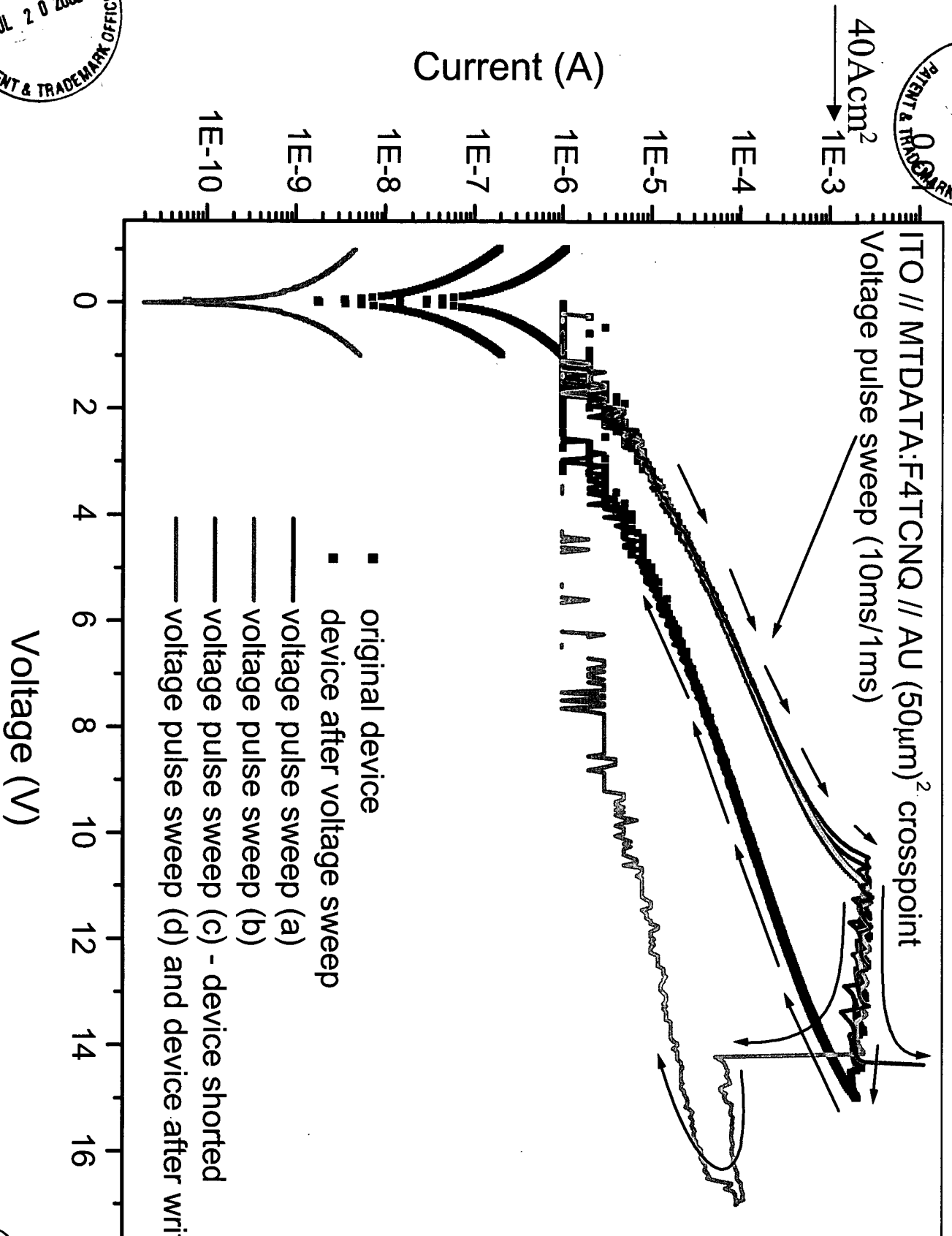


Open circuit

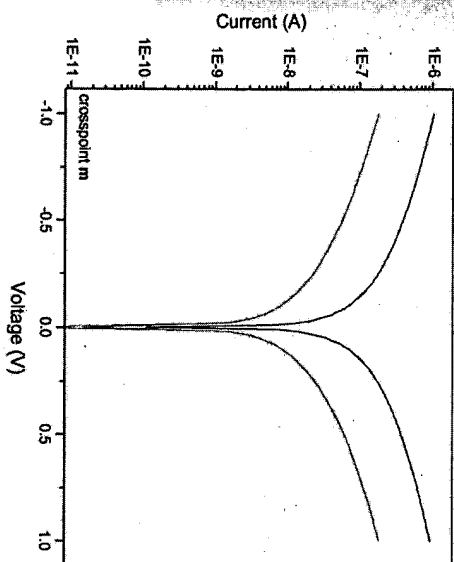
- Top contact rippled
- 'Hot spots' broke through

More crosspoints: Shorted devices Shorts @ similar current densities ($\sim 10\text{-}50\text{A/cm}^2$)





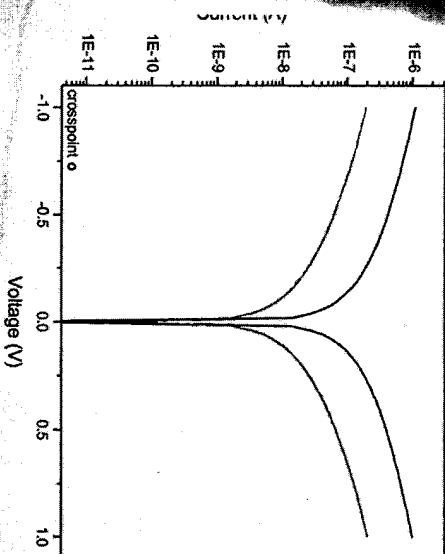
m01.tif



Acc.V Spot Magn WD Exp 5.00 kV 3.0 1752x 10.7 0

20 μ m

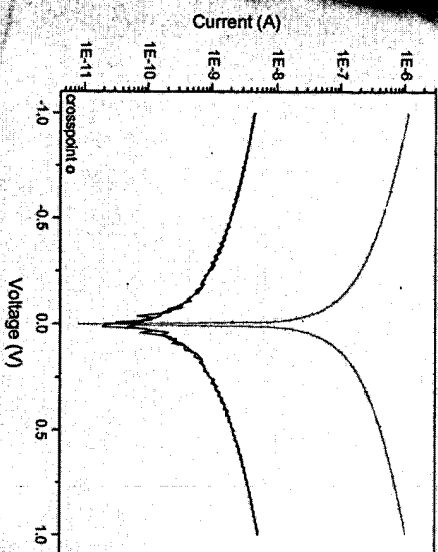
n01.tif



Acc.V Spot Magn WD Exp 5.00 kV 3.0 1752x 11.3 0

20 μ m

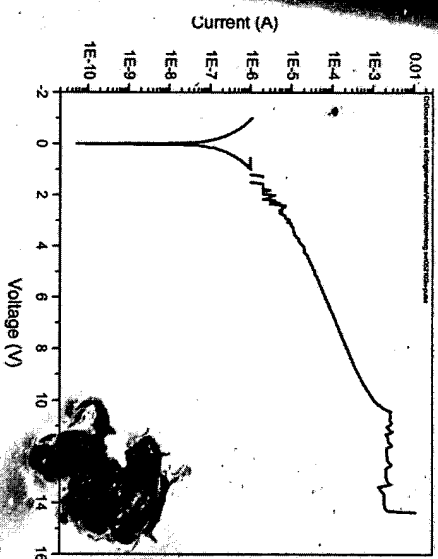
o01.tif



Acc.V Spot Magn WD Exp 5.00 kV 3.0 1752x 11.3 0

20 μ m

p01.tif



Acc.V Spot Magn WD Exp 5.00 kV 3.0 1752x 10.7 0

20 μ m

Overview: Conductivity of PEDT:PSS films

Substrate preparation:

- Solvent cleaning
- O₂ plasma of UV/ozone treatment

Film preparation:

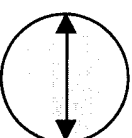
- Spinning @4000rpm, 40s, 300K
- Baking in vacuum oven @130C, 15min
- Subsequent layers w/o surface treatment
- Single layer on ITO: *thickness ~30nm*

Devices

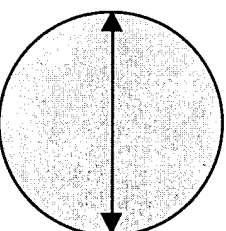
- 4 different thicknesses (1 to 4 layers)
- 3 different dot sizes



$d \sim 0.04 \text{ mm}$
 $A = 1.25 \cdot 10^{-5} \text{ cm}^2$



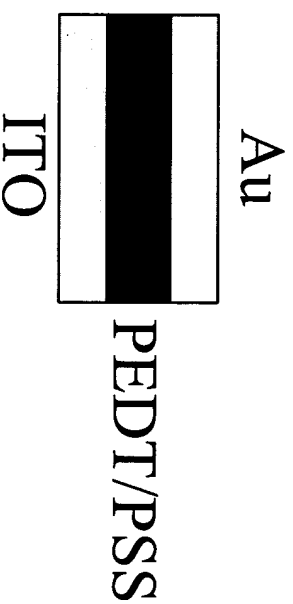
$d \sim 0.3 \text{ mm}$
 $A = 7.1 \cdot 10^{-4} \text{ cm}^2$



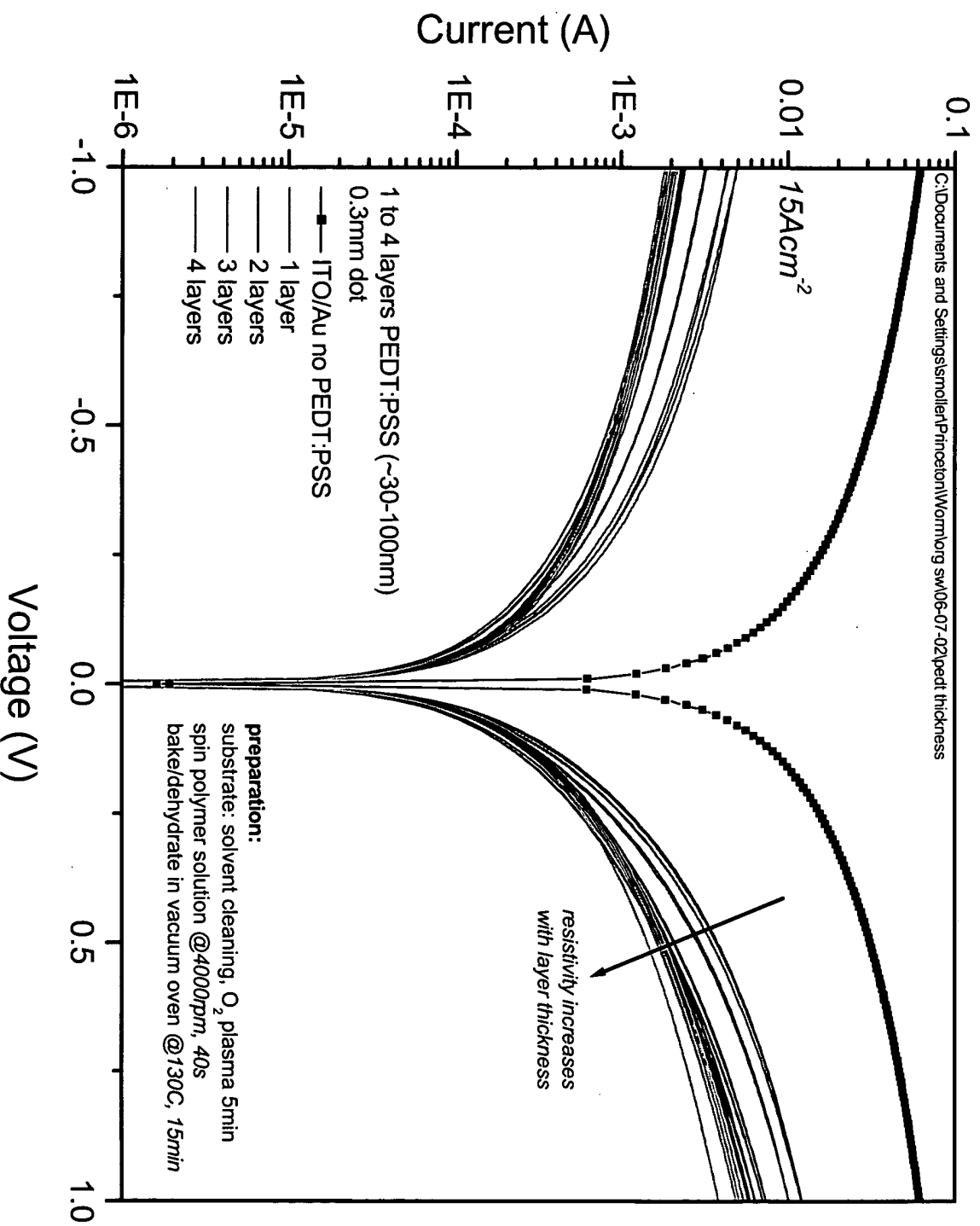
$d \sim 1 \text{ mm}$
 $A = 7.8 \cdot 10^{-3} \text{ cm}^2$

Results

- Thin films measurable (*page 2*)
- High current densities $\sim 1000 \text{ A cm}^{-2}$ (*page 3*)
- Breakdown of polymer observed, mechanism unknown (*page 4*)
- Top metal not affected by breakdown (polymers exist in vapor phase)

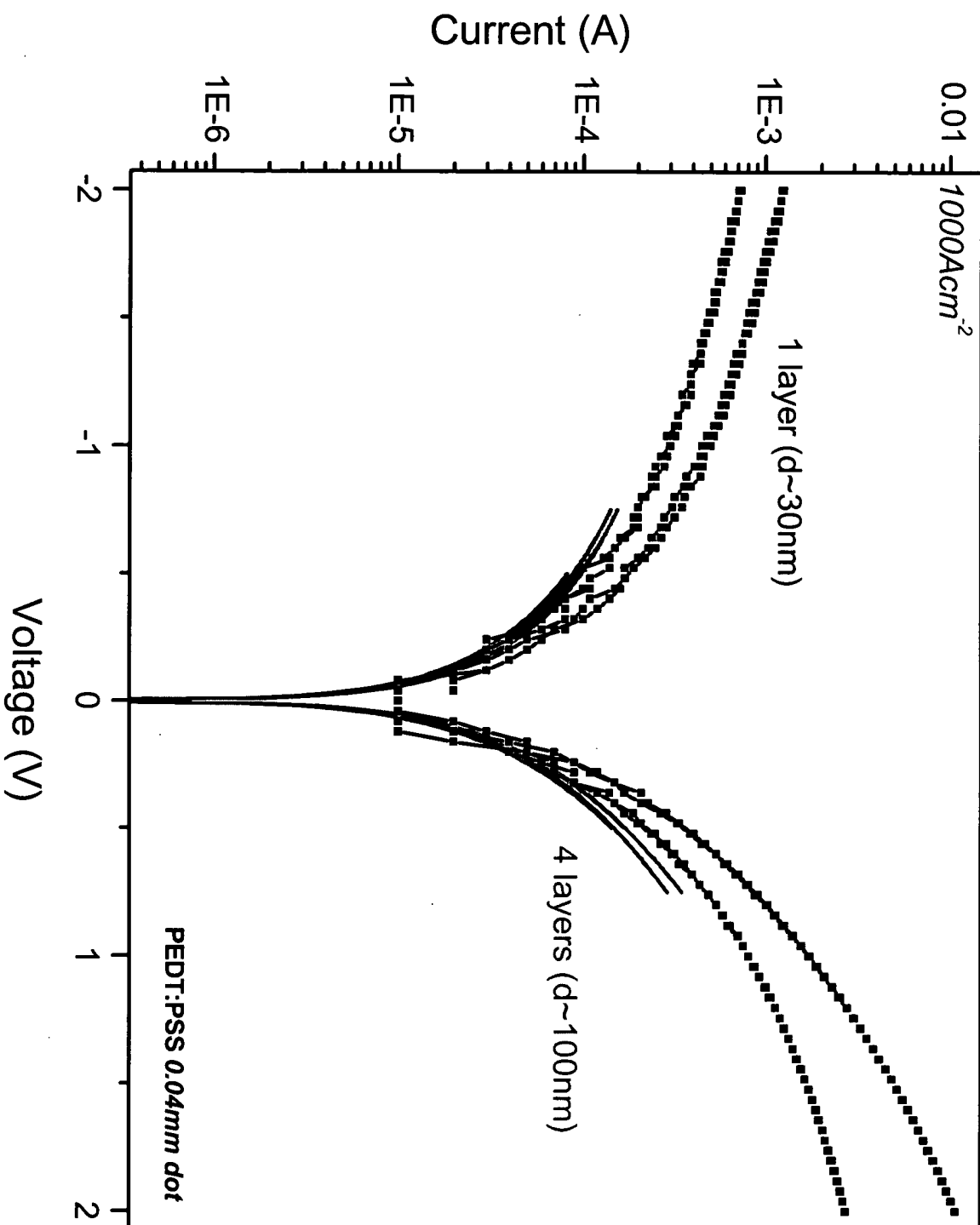


Medium dots (*Comparison w/ Au dot on ITO*)

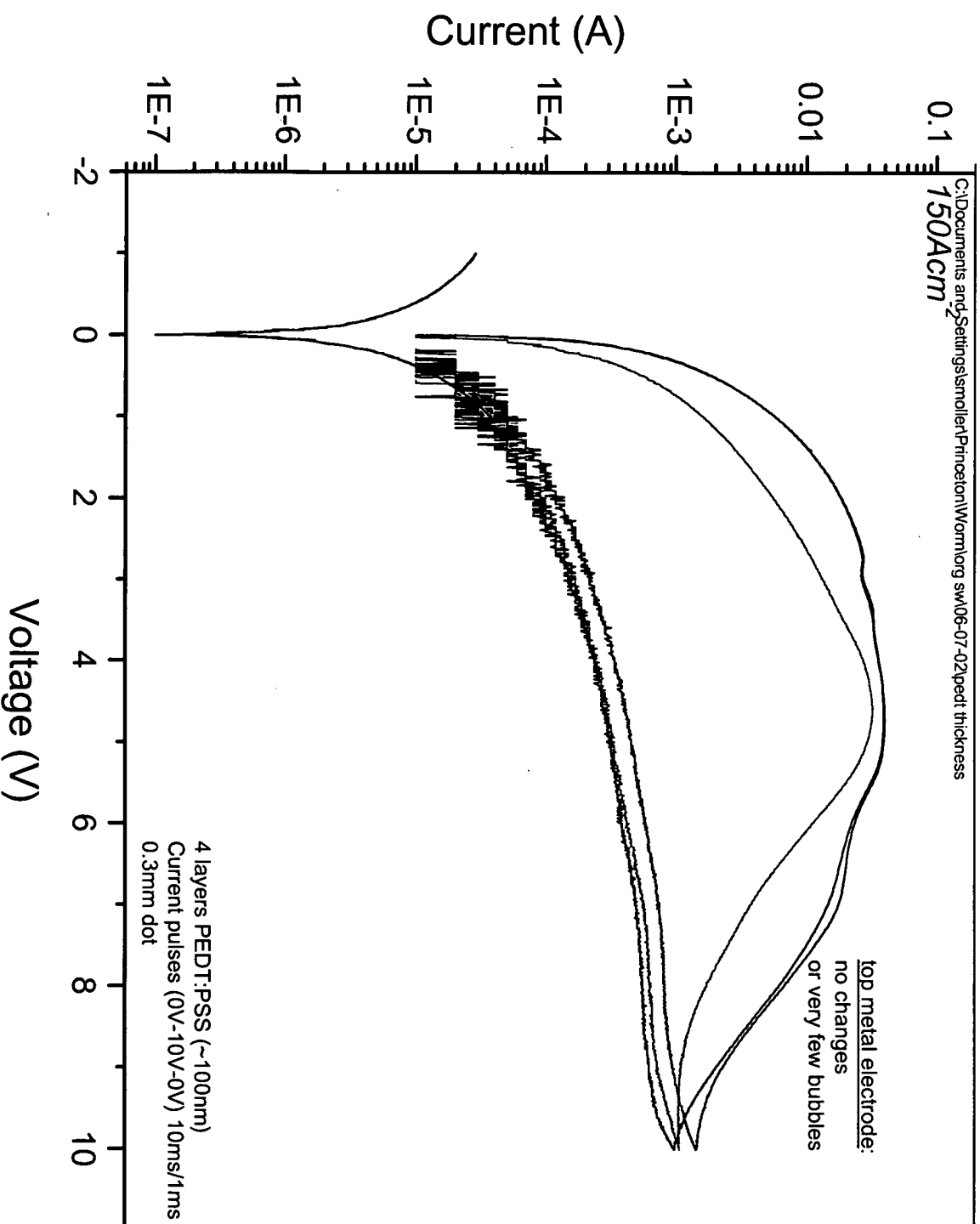


Small dots

C:\Documents and Settings\smaller\Princeston\Wormlog sw06-07-02\pedt thickness



Voltage pulses (1ms/20ms // Medium dots, 4 layers)



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